Peter Chung-Man Ho was born in Hong Kong on October 13, 1970. He received a B. Sc. degree in electrical engineering from Virginia Polytechnic Institute and State University in 1991. In September 1990, he joined the Optical Image Processing Lab of Virginia Polytechnic Institute and State University where he served as an undergraduate research assistant. In August 1991, he joined the Mobile and Portable Radio Research Group (MPRG) of Virginia Tech where his graduate research focused on indoor propagation for future Personal Communication Systems. His research interest includes Personal Communication Systems, antenna design, propagation prediction, and optical image processing.

Mr. Ho is a member of Tau Beta Pi.

EXHIBIT D

520 S. El Camino Real, Suite 715, San Mateo, CA 94402

EXHIBIT D

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
RADIOSTATIONCONSTRUCTIONPERMIT
AND LICENSE

EXPERIMENTAL	K F 2 X F P
(Nature of Service)	(Call Sign)
XD FX & MO	1627-EX-PL-90
(Class of station)	(File number)

NAME EASYPHONE, INC.

(1) Within 75 mile radius of San Francisco, CA: (2) city limits of
(Location of station)
Los Angeles, CA

Subject to the provisions of the Communications Act of 1934, subsequent acts, and treaties, and all regulations heretofore or hereafter made by this Commission, and further subject to the conditions and requirements set forth in this license, the licensee hereof is hereby authorized to use and operate the radio transmitting facilities hereinafter described for radio communications.

Frequency MHz	Authorized Power (watts)	Emission Designator
864-868.1	100 milliwatts (ERP)	(1)
930-931	100 milliwatts (ERP)	(1)
940-941	100 milliwatts (ERP)	(1)
930-960	100 milliwatts (ERP)	(1)

Frequency Tolerance: ± 0.005%

Operation: In accordance with Sec. 5.202(h) & (j) of the Commission's Rules.

Special Conditions:

(1) Licensee is authorized to use various modes of modulation, bandwidth, and data rates. None of these modes of transmission shall extend beyond the band limits set forth above.
(2) The licensee is required to file a progress report with the FCC every six months to include the types of emissions used and technical findings. The report should be filed with FCC, Frequency Liaison Branch, Room 7326, Washington, DC 20554.
(3) The station identification requirements of Section 5.152 of the FCC rules are waived.
(4) Licensee should be aware that other station may be licensed on these frequencies and if any interference occurs, licensee of this authorization will be subject to immediate shut down.

This authorization effective February 20, 1991 and will expire 3:00 A.M. EST February 1, 1993

FEDERAL COMMUNICATIONS COMMISSION

FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

Approved by OMB
3060-0065
Expires 12/31/92

Public reporting burden for this collection of information is estimated to average 4 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Federal Communications Commission, Office of Managing Director, Washington, DC 20554, and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Paperwork Reduction Project (3060-0065), Washington, DC 20503.

APPLICATION FOR NEW OR MODIFIED RADIO STATION AUTHORIZATION UNDER PART 5 OF FCC RULES - EXPERIMENTAL RADIO SERVICE (OTHER) THAN BROADCAST)

A. Applicant's Name and Post Office address
(Give street, city, state, and ZIP Code. See Instruction No. 4)

EasyPhone, Inc.
520 S. El Camino Real, Suite 715
San Mateo, CA 94402

DO NOT WRITE IN THIS BLOCK

File No.

2.(a) Application for *(check only one box)*

☒ New Station ☐ Modification of existing authorization

2.(b) For Modification indicate below

File No.: Call Sign:

3. Application for modification indicate change in (check all that apply)

☐ Frequency ☐ Emission ☐ Power ☐ Location

☐ Other particulars *(describe below or in attached Exhibit No. _____)*

4. Particulars of Operation *(See instructions below)*

Frequency (State Whether kHz or MHz) (A)	POWER (B)	(C)	(D)	EMISSION (E)	MODULATING SIGNAL (F)	NECESSARY BANDWIDTH (kHz) (G)
864-866 MHz	10 mW	100 mW	Mean	various	audio	various
930-960 MHz			Mean	various	audio	various

(A) List each frequency or frequency band separately. (If more space is required, attach as Exhibit No. _____).
(B) Insert maximum R.F. output power at the transmitter terminals. Specify units.
(C) Insert maximum effective radiated power from the antenna (If pulsed emission specify peak power).
(D) Insert "MEAN" or "PEAK" (See definitions in Part 5).
(E) List each type of emission separately for each frequency. (See Section 2.201 FCC Rules.)
(F) Insert as appropriate for the type of modulation:
(1) the maximum speed of keying in bauds;
(2) maximum audio modulating frequency;
(3) frequency deviation of carrier.
(4) pulse duration and repetition rate.
For complex emissions, describe in detail in the space provided below.
(G) Describe how the necessary bandwidth was determined in space provided below.

5(a). Proposed location of transmitter and transmitting antenna (Check only one box)

☐ FIXED/BASE ☐ MOBILE ☒ BASE & MOBILE

(b) If permanently located at a fixed location, give below

State	County	City or Town

Number and street (or other indication of location)

(d) If mobile, describe the exact area of operation

Within a 75 mile radius of San Francisco, CA

(c) Geographical coordinates exact to the nearest second

North Latitude	West Longitude
° ' "	° ' "

(e) Geographical coordinates of the approximate center of proposed area of operation (mobile applications)

North Latitude	West Longitude
° ' "	° ' "
37 46 39	122 24 40

6. Is a directional antenna *(other than radar)* used? ☐ Yes ☒ No

If "YES", give the following information:

(a) Width of beam in degrees at the half-power point _____
(b) Orientation in horizontal plane _____
(c) Orientation in vertical plane _____

7. Is this authorization to be used for fulfilling the requirement of a government contract with an agency of the United States Government? ☐ Yes ☒ No

If "Yes", attach as EXHIBIT No. _____, a narrative statement describing the government project, agency, and contact number.

8. Is this authorization to be used for the exclusive purpose of developing radio equipment for export to be employed by stations under the jurisdiction of a foreign government? ☐ Yes ☒ No

If "Yes", attach as EXHIBIT No. _____, the following information:
(a) The contract number and the name of the foreign government concerned.

9. Is this authorization to be used for providing communications essential to a research project? (The radio communication is not the objective of the research project). ☐ Yes ☒ No

If "Yes", attach as EXHIBIT No. _____, a narrative statement providing the following information:
(a) A description of the nature of the research project being conducted.
(b) A showing that the communications facilities requested are necessary for the research project involved.
(c) A showing that existing communications facilities are inadequate.

10. If all the answers to Items 7, 8, and 9, are "No", attach as EXHIBIT No. 1, a narrative statement describing in detail the following:

(a) The complete program of research and experimentation proposed including description of equipment and theory of operation.
(b) The specific objectives sought to be accomplished.
(c) How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion, or utilization of the radio art, or is along line not already investigated.

11. (a) Give an estimate of the length of time that will be required to complete the program of experimentation proposed in this application.

(b) If less than 2 years, give the length of time in months that the authorization requested in this application will be required. 2 years

12. Would a Commission grant of this application come within Section 1.1307 of the FCC Rules, such that it may have a significant environmental impact? ☐ Yes ☒ No

If you answer yes, submit an Environmental Assessment required by Section 1.1311.

13. List below transmitting equipment to be installed (if experimental, so state):

MANUFACTURER	TYPE	NO. OF UNITS
Experimental		

14. Is the equipment listed in Item 13 capable of station identification pursuant to Section 5.152?

☐ Yes ☒ No

15. Will the antenna extend more than 6 meters above the ground, or if mounted on an existing building will it extend more than 6 meters above the building, or will the proposed antenna be mounted on an existing structure other than a building?

☐ Yes ☒ No

If "Yes", give the following (See Instruction 9):

(a) Overall height above ground to tip of antenna is _____ meters.

(b) Elevation of ground at antenna site above mean sea level is _____ meters.

(c) Distance to nearest aircraft landing area is _____ kilometers.

(d) List any natural formations of existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft and thereby minimize the aeronautical hazard of the antenna.

(e) Submit as EXHIBIT No. _____, a vertical profile sketch of total structure including supporting building, if any, giving heights in meters above ground for all significant features. Clearly indicate existing portion, noting particulars of aviation obstruction lighting already available.

16. Applicant is *(check only one box)*

☐ Individual ☐ Association ☐ Partnership ☒ Corporation
☐ Other *(describe below)*

17. Is applicant a foreign government or a representative of a foreign government?

☐ Yes ☒ No

18. Has applicant or any party to this application had any FCC station license or permit revoked or had any application for permit, license or renewal denied by this Commission?

☐ Yes ☒ No

If "Yes", attach as EXHIBIT No. _____, a statement giving call sign of license or permit revoked and relate circumstances.

19. Will applicant be owner and operator of station?

☒ Yes ☐ No

20. Give name, title, and telephone number (include area code) of person who can best handle inquiries pertaining to this application.

Raymond A. Kowalski (202) 828-5536

21. List below all exhibits in numerical sequence and the item number of form requiring the exhibit identified.

EXHIBITS AND ITEM NO. OF FORM

Exhibit Number	Item No. of Form	Exhibit Number	Item No. of Form	Exhibit Number	Item No. of Form
1	10				

22. CERTIFICATION

ATTENTION: Read this certification carefully before signing this application.

THE APPLICANT CERTIFIES THAT:

(a) Copies of the FCC Rules Parts 2 and 5 are on hand; and

(b) Adequate financial appropriations have been made to carry on the program of experimentation which will be conducted by qualified personnel; and

(c) All operations will be on an experimental basis in accordance with Part 5 and other applicable rules, and will be conducted in such a manner and at such a time as to preclude harmful interference to any authorized station; and

(d) Grant of the authorization requested herein will not be construed as a finding on the part of the Commission

(1) that the frequencies and other technical parameters specified in the authorization are the best suited for the proposed program of experimentation, and

(2) that the applicant will be authorized to operate on any basis other than experimental, and

(3) that the Commission is obligated by the results of the experimental program to make provision in its rules including its table of frequency allocations for applicant's type of operation on a regularly licensed basis.

APPLICANT CERTIFIES FURTHER THAT:

(e) All the statements in the application and attached exhibits are true, complete and correct to the best of the applicant's knowledge, and

(f) The applicant is willing to finance and conduct the experimental program with full knowledge and understanding of the above limitations; and

(g) The applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the USA.

Signed and dated this _____ day of September, 1990.

Name of Applicant EasyPhone, Inc.

(correspond with name given on page 1)

By John O. Lockton, Jr. J. O. Lockton

(print) *(signature)*

Title President

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND IMPRISONMENT. U.S. CODE, TITLE 18, SECTION 1001.

Check Appropriate Classification:

- ☐ Individual Applicant
- ☐ Member of Applicant Partnership
- ☐ Office of Applicant Corporation or Association
- ☐ Authorized Employee

NOTIFICATION TO INDIVIDUALS UNDER PRIVACY ACT OF 1974 AND THE PAPERWORK REDUCTION ACT OF 1980

Information requested through this form is authorized by the Communications Act of 1934, as amended, and specifically by Section 308 therein. The information will be used by Federal Communications Commission staff to determine eligibility for issuing authorizations in the use of the frequency spectrum and to effect the provisions of regulatory responsibilities rendered the Commission by the Act. Information requested by this form will be available to the public unless otherwise requested pursuant to Section 0.459 of FCC Rules and Regulations. Your response is required to obtain this authorization.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3), and the Paperwork Reduction Act of 1980, P.L. 96-511, December 11, 1980, 44 U.S.C. 3507.

Exhibit 1

The Applicant

EasyPhone™ is a Delaware corporation which was formed in 1989 for the purpose of building personal communications networks. The principals of EasyPhone™ have been active in personal communications services ("PCS") from the initial discussions of PCS for the U.S. market.

They were the very first group to bring to the FCC's attention the now familiar CT2 technology[1]. They were the first to bring PCS to the broad attention of the U.S. cellular industry and addressed the CTIA technical committee on the subject of PCS at its Winter, 1989, San Antonio meeting. One of the principals was a member of the FCC panel in July, 1989, which for the first time discussed various PCS approaches in an open, FCC sponsored forum[2]. Since that time, the principals of EasyPhone™ and EasyPhone™ itself has continued to be most active in PCS, including:

- Having one or more of the principals involved in each major U.S. conference on PCS.
- Conducting extensive market study. This has verified a U.S. market for PCS of between 35 and 60 million Americans by the end of this decade.
- Conducting a thorough review of existing and potential future digital PCS technology -- CT2, DECT, GSM, digital AMPs (standard for U.S. digital cellular) and CDMA. This has involved extensive meetings and analysis in the U.S. and abroad with present and future personal communications equipment suppliers and operator participants.
- Thoroughly analyzing all U.S. PCS experimental license applications to date and the technology involved for compatibility with the FCC's N.O.I. on PCS (Docket 90-314), achievability, consumer costs, features, capacity and time to manufacturing production.

---

[1]Letter of January 31,1989, to Dr. Thomas P. Stanley, Chief, Office of Engineering and Technology on behalf of Corporate Technology Partners™, the then partnership of the principals.

[2]See, for example the views expressed during the Commission's CT2 tutorial, "The future of CT2 Personal Mobile Communications," held in Washington in July, 1989. See also comments filed in RM7140 and RM7175.

What EasyPhone™ has been seeking is a PCS approach which:

1. Allows two way calling in public use.
2. Allows handoff so that users can continue calls as they move at least slowly from cell to cell.
3. Has capacity to serve major office complexes with PBX -based wireless communications.
4. Provides data transmission capacity.
5. Operates as far as possible with existing technologies and in frequencies where components are readily available or manufacturable. This will allow early introduction and low cost for maximum consumer benefit.
6. Supports value added services and offers a high level of security.
7. Most important of all, allows frequency sharing on a secondary basis with existing frequency users. This will provide U.S. PCS services with an opportunity to lead the world in PCS.

There has now been developed a new approach which will satisfy these seven goals. The approach is revolutionary and unique. We call the approach PC-1 (Personal Communications-1). EasyPhone seeks to pioneer PC-1 through this experimental license. Patents are being applied for with the technology developer.

As noted above, EasyPhone™ has broad knowledge of all alternative technologies having reviewed each of these technologies in detail. It has taken the time to analyze these technologies, not as stand-alones, but as part of a U.S. mass market PCS. It has waited to file for experimental license until a complete PCS system could be developed which fully answers the needs expressed by the FCC in its N.O.I. on PCS while allowing early low cost manufacturing. Also, a leadership position for the U.S. in PCS was sought.

The system proposed (PC-1) is discussed in more detail in Attachment 1 hereto.

It should be noted that the corporate charter of EasyPhone™ is to develop a U.S. PCS service, not any particular technology. EasyPhone™ believes that PCS of the future will involve an integration of many system approaches -- cellular, digital cellular, and various microcellular approaches. These will be linked seamless to allow the user to be

PHASE I

EasyPhone™ has formed business alliances with companies who will be installing equipment or conducting experiments with available PCS equipment in other parts of the world. These experiments are beginning and will generally utilize 864-868 MHz.

EasyPhone™'s initial round of testing will also be at 864-868 MHz. Maximum output power will be 100 milliwats. The equipment will initially consist of four public base stations, 50 handsets, and 10 residential base stations. This may be increased as test needs dictate.

Information derived from the PCS equipment installations and experiments elsewhere in the world will be shared with EasyPhone™. EasyPhone™, in turn, proposes to develop similar information relevant to the U.S. experience and share it. Particularly there will be sharing with Canada. EasyPhone™ believes that the history of cooperation between the two nations, and the desirability of technically compatible equipment between neighboring countries, warrant the exploration of common operating standards. The same is true of Mexico where the principals of EasyPhone also have involvement. Phase I testing will consist of:

Technology Studies

1. Propagation. EasyPhone™ seeks to gain its own experience with regard to the signal propagation properties of CT2 technology. EasyPhone™ seeks to learn the reliable range of CT2 in various typical locations, such as office buildings, apartments, houses, and public streets and places. For example, early results in the UK show ranges of 150 to 600 feet depending upon location.

2. Interconnection. EasyPhone™ seeks to gain experience in the interconnection of radio-based handsets with the public switched telephone network. Call set up, network authorization, and billing, now familiar concepts, may have unique requirements in the context of PCS. In this connection there will be testing of advanced concepts which will lead to the accomplishment of the hand off at pedestrian speeds and two-way calling discussed for PC-1 in Attachment 1 hereto.

3. Installation. EasyPhone™ seeks to learn the nature of optimum sites for CT2 PCS public base stations; to learn the outer limits of feasibility when optimum sites are not available; and to learn the typical obstacles and their solutions. EasyPhone™ also hopes to learn if site requirements differ between present CT2 and the PC-1 system proposed in Attachment 1 hereto.

4. Failure rate. The reliability of new equipment is always a concern. EasyPhone™ seeks to learn first hand what to expect in this regard.

5. Channel blocking/channel failure. As reflected in the other experimental license filings, comments in Commission rule making proceedings and presentations made in industry seminars, there is considerable debate among proponents of new PCS technologies about the capacity of any particular technology to handle high demand applications, such as a wireless PBX that serves an entire office building. EasyPhone™ believes that the PC-1 system proposed in Attachment 1 is capable of supporting high-capacity use through its ability to manage large blocks of spectrum. Experimentation with existing CT2 technology at 864-868 MHz will provide the "base case" against which to test the greater capacity of PC-1.

6. Product definition. PCS handsets must be small and light. EasyPhone™ will seek to gain feedback from users as to what other properties the handsets should possess.

Market Studies

EasyPhone™ has consultants' reports of the potential PCS market. By this experiment, EasyPhone™ will seek to validate these studies and learn which population segments can be expected to use the service and for what purposes.

EasyPhone™ also seeks to gain information with regard to volume; peak traffic periods; local versus long distance calling; and the like.

Finally, EasyPhone™ will attempt to identify desired value added services coverage patterns. For the market studies with 864-868 MHz equipment, EasyPhone™ intends to use diaries and focussed group interview procedures.

For the 864-868 MHz Phase I testing, some of the equipment may be loaned by manufacturers rather than owned. EasyPhone™ thus requests the Commission to waive the requirement of Rule 5.206 that it "own" any equipment that is used in its market studies. EasyPhone™ believes that the intent of this rule is to ensure that experimental equipment is not sold to the public and to ensure licensee control over the equipment. These conditions will both be met, but EasyPhone™ may not necessarily "own" the equipment in its own right.

PHASE II

EasyPhone™ is pursuing development of PC-1 with the advanced features, including frequency sharing, listed in Attachment 1 hereto. The system approach is best supported by dedicating 930-931 MHz and 940-941 MHz for PCS and allowing frequency sharing on a secondary use basis with 10 MHz of additional spectrum in that region, spectrum now allocated to fixed microwave. Accordingly, EasyPhone™ asks in Phase II to be able to experiment with 930-931 MHz and 940-941 MHz on a primary use basis and with selected fixed microwave frequencies within the 930 MHz to 960 MHz range on a secondary usage basis. Added together, these selected frequencies will provide a total of 10 MHz of usable frequency in even those cities where most active use of fixed microwave occurs. The PC-1 system described in Attachment 1 provides the same effect as 10 MHz of contiguous frequency. Further, by choosing 930 MHz to 960 MHz there will be overlap with the indicated Canadian frequencies for PCS -- 944 MHz to 952 MHz. This should allow roaming between the U.S. and Canada.

The Phase II testing will be technical testing of PC-1. It will follow-on from and be an outgrowth of the initial 864-868 MHz testing (which will help in the final development of PC-1). The equipment used will initially be emulation and then prototype equipment. Testing will start in 1991 following completion of Phase I testing and analysis of results. The Phase II testing will include:

1. Determination of capability to exist with fixed microwave. Testing will establish that PC-1 does not interfere with and is not interfered with by fixed microwave.
2. Capacity both in office and public use.
3. The base technology for two-way calling and hand off at pedestrian speeds.
4. Ability to provide value added services.

5. Ability to provide data services.
6. Ability to offer secure transmission.

We expect that in 1992, EasyPhone™ will be able to demonstrate a stable, easily manufacturable system which provides high capacity, low cost, full PCS services on a frequency shared basis with fixed microwave. We believe that PC-1 should be the first generation U.S. PCS.

Test Locations

PHASE I

For its test of presently available PCS equipment at 864-868 MHz, EasyPhone™ proposes to establish a test location in a California city with a population of approximately 50,000. Candidate cities are Napa, Davis, Fairfield, Modesto, or Salinas. EasyPhone™ would, however, accept a license in any similar Northern California city if the Commission's review of this application so dictated.

PHASE II

For its test of the PC-1 system, EasyPhone™ seeks authorization to use the band 930-960 MHz within a 40-mile radius of the City of San Francisco, and also within the city limits of the City of Los Angeles. Within this band, EasyPhone™ intends to use the unallocated segments at 930-931 MHz and 940-941 MHz. Approximately 10 MHz elsewhere in the band will be identified on the basis of the presence of fixed microwave users. (Mobile users will be avoided.) On this spectrum, EasyPhone™ intends to tests PC-1, sensing occupied frequencies and avoiding them in allocating a PC-1 channel to a call.

San Francisco and Los Angeles are chosen because they offer variety of terrain, substantial fixed microwave density of use with which to experiment, and are close to EasyPhone™ headquarters.

License Term and Reports

EasyPhone™ requests an experimental license for a two-year term. EasyPhone™ proposes to file an experimental report at the conclusion of Phase I of its program of experimentation. In view of the fact that EasyPhone™ will be developing a proprietary system in Phase II of its program, EasyPhone™ requests that it not be required to file an experimental report. In the alternative, if the Commission desires one or more experimental reports, EasyPhone™ requests that it be allowed to withhold proprietary information or to submit such information with a request for confidentiality under Rule 5.204(c).

Station Identification

EasyPhone™ requests to be exempt from the station identification requirements of Rule 5.152.

Attachment 1

TECHNOLOGY DISCUSSION

I. TECHNOLOGY CHOICE

There are five digital transmission technologies that could be chosen for PCS: CT2, DECT, GSM, Digital AMPS (U.S. digital cellular choice) and CDMA. Each technology has its proponents and various advantages and disadvantages. We expect many of these technologies will be employed in various generations of PCS.

The only one of these technologies currently available is CT2. CT2 components are beginning to be manufactured in volume. This means CT2 is better positioned than alternative technologies to provide early, low cost mass market PCS. Also, unlike alternative technologies, the capabilities of CT2 have been fully tested and are known.

It is important to note that CT2 is quite frequency efficient compared to most other technologies in terms of numbers of users that can be supported per megahertz. Also, it is being adopted worldwide as first generation PCS. This means that by employing CT2 technology with advanced network capabilities and other enhancements (which is what is here proposed), U.S. manufacturers will have an excellent chance of a worldwide market and the U.S. a leadership position in first generation PCS.

The first CT2 service introduced in the UK has several well publicized drawbacks. Two-way calling is unavailable in the public environment. Handoff is not provided (i.e., the user must re-register as he or she moves among UK CT2 cells). Capacity is somewhat limited, meaning only 30-40% of a densely populated office could be served by a wireless CT2 PBX. Data transmission is unavailable. **All of these drawbacks relate to the way the CT2 service provision is constituted in the UK, not to the CT2 technology. CT2, as a technology, has virtually the same capability as DECT, GSM, digital AMPs or CDMA to provide full PCS service.**

called anywhere through RF on a single personal number and at charge rates comparable to today's landline rates.

PC-1 is brought forward as an important step toward this goal of eventual integration. PC-1 satisfies most current PCS needs with components that are readily available or easily manufacturable. Further, the frequency sharing approach of PC-1, if adopted as the first U.S. PCS system, will put America in the lead for PCS in many countries worldwide where frequency is scarce.

Additional technology development will be needed and will occur in future years as we move toward the final PCS system approach. EasyPhone™ intends to remain in the forefront of this development. EasyPhone™ will be filing in the future for a second experimental license. This will be to experiment with spread spectrum in a form particularly adapted for frequency sharing with fixed microwave. Spread spectrum, properly utilized, allows excellent frequency sharing. It could be used as it develops in the future to complement and eventually replace the first generation PCS being proposed by EasyPhone™. EasyPhone™ intends to pioneer in spread spectrum just as in first generation PCS.

The Program of Experimentation

Supplementary Statement Pursuant to Rule 5.57(a)

EasyPhone™ seeks an experimental authorization pursuant to Rule 5.202, subsections (i), development of radio technique, equipment, operational data or engineering data related to an existing or proposed radio service, and (j), limited market studies. EasyPhone™ proposes two phases.

First, to explore basic CT2 PCS technologies using equipment available from the UK experience and also use this equipment for market studies confirming previous EasyPhone market research.

Second, to gain experience with the frequency sharing PCS system here proposed.

Having analyzed all available digital transmission approaches, CT2 has been chosen as the approach which is here now and which has the needed capabilities. The system here proposed involves adding to CT2 the network and signalling features found in a full PCS (or in the UK a PCN). The result is a system with all the attributes desired in at least the first generation of PCS -- two-way calling, hand off at pedestrian speeds, data transmission, higher capacity in office and public use, and low equipment and transmission cost. Further, because of use of the basic worldwide Common Air Interface Specification ("CAIS") standard of CT2, the U.S. handsets will be compatible in Europe and in the many other countries where CT2 is being adopted. Particularly, there should be the opportunity to use the same handset in the U.S., across the border in Canada, and ultimately in Mexico. We call the system, with its advanced network capabilities, PC-1.

From development of PC-1 comes another capability, the most vital of all. In developing the needed networking and operational capabilities, **the problem of U.S. frequency availability seems also to have been solved.** PC-1 can operate comfortably in any and all 900 MHz frequencies currently occupied by fixed point to point or point to multipoint microwave. This means PC-1 could be adopted today by the FCC and immediately put in place as it is based on existing CT2 technology. It could be introduced without displacing any current users. And, it could quickly provide low cost PCS to the 35 to 60 million Americans that our research shows want PCS.

The uniqueness of the system and its frequency sharing capability has led to seeking patent protection. However, it is our hope that the system would be widely available to and adopted in the U.S. for world distribution.

II. CT2 CAIS

CT2 CAIS is an open standard. It deliberately leaves sections of the message space undefined in order to accommodate future expansion of services and facilities. For example, CT2 CAIS already provides for the addition of data

and security features. What is being proposed in PC-1 is implementation of the full features and capabilities of CT2 under CAIS.

III. COMMON SIGNALLING CHANNELS

The PC-1 system proposed is for 80 channels of 100 KHz each. Channels 1, 2, 79 and 80 are reserved for use as common signalling channels ("CSCs"). The purpose of adding CSCs to the CT2 system is to provide the following improvements: call set up to the base station with the strongest signal (thereby extending system capacity and performance), faster call set up, decreased scan-time requirement for the handset (thus extending battery life), and facilitation of delivery of data and other value added services.

Each of the four carriers reserved for PC-1 CSC supports eight CSCs in TDMA mode. Thus, there are 32 PC-1 CSCs in total. The transmission rate and modulation approach are those specified in CAIS.

IV. CSC SELECTION

A PC-1 base station selects a CSC on which to operate by use of an algorithm. Using this algorithm, the base station scans all CSCs and selects the best CSC on which to operate.

The PC-1 base station may put the CSC into four modes: broadcast mode -- broadcast information to all handsets; emergency broadcast mode -- vital information to all handsets; paging mode -- information to a specific handset and similar to paging channel use in cellular radio; and conversation mode -- a communication link established to a particular handset, again like cellular radio. The broadcast mode is the "stand-by" mode of the base station allowing the handset seeking to register with the base station of highest signal strength to register with that base station. Emergency broadcast mode is used when the base station has broadcast information for all handsets and wants to force reading of the information.

V. REGISTRATION

One of the advantages of the proposed PC-1 system is that it allows automatic registration of the handset. Automatic registration occurs by simply turning on the handset. The handset, having scanned all CSCs, chooses a base station on which to attempt registration. This normally will be the base station whose CSC gives the highest field strength reading. The handset waits until the base station is in broadcast or emergency broadcast mode before starting the registration.

Registration for PC-1 occurs by the handset transmitting certain identification and numbering information on the reverse channel time slot of the CSC chosen. As long as it is turned on, the handset regularly re-registers its presence. This allows a handset which has been moved to another microcell (served by another base station) to be located for inbound calls to the handset.

VI. CALL SET UP

The registration information received by the PC-1 base station is utilized through out of band signalling channels approaches to allow a call to a subscriber's home central office to be routed to the PC-1 base station in which the subscriber is registered. This base station then polls the handset through the CSC which the handset is monitoring. The base station keeps track of which voice traffic channels are free. Through the polling process the handset and the base station agree on the traffic channel which will carry the transmission. The base station always has the last word on the channel selected, but the handset has a say. The base station sends a list of free channels to the handset. The handset checks these channels and confirms its first choice back to the base station. The base station then instructs the handset to switch to the agreed upon channel and the call set up is completed.

For calls originating from the PC-1 handset the process is similar. The base station announces the free channels through CSC paging and a call is set up on the best available traffic channel.

VII. HANDOFF WITHIN CELL

This type of handoff (i.e., to a new frequency on the same PC-1 base station) normally occurs to avoid interference. Typically, interference occurs instantly without warning. For example, another call established on the same channel in a distant cell may lead to unacceptable interference of a call in progress.

As noted above, the PC-1 base station and the PC-1 handset (while in use) maintain a list of candidate free channels to hop to if and when interference suddenly arises. This list is maintained routinely, not just when handoff is required. Link reestablishment on a different channel may occur at either the request of the base station or of the handset. The CSC is used by the base station to order a switch to a new channel and this switch is nearly instantaneous.

VIII. HANDOFF TO A NEW CELL

This type of handoff is typically caused by movement of the PC-1 handset out of a cell. The received signal strengths of the base station and handset gradually decrease as, for example, a caller walks across an airport to catch a flight.

Link reestablishment to a different PC-1 base station may be initiated either from the base station or handset. Part of the approach is similar to cellular radio handoffs. A central software and switching capability is alerted to the possible need for a handoff by signal from the base station. The central switch then instructs adjacent base stations to monitor for signal strength. The base station with best signal strength is selected. This base station then contacts the handset for the handoff by paging through a CSC. From the list of free channels in the second base station a free channel is selected. The handset and call are then switched to the selected free channel in virtual seamless fashion almost the same

way as the intra-cell handoff discussed above. This PC-1 handoff capability is now in development.

It should be noted the proposed PC-1 system allows hand off at pedestrian speeds only. For fully mobile use the handset has the capability of accessing the car mounted equipment of a cellular phone for retransmission through cellular radio. The connection to the cellular car equipment which will allow this is under development. This means that a single PC-1 handset will be usable in the home with a residential base station, in the office with a wireless PBX, in the street with hand off at pedestrian speeds, and in the car or other vehicle with fast handoff. Also, the cellular equipped vehicle becomes a mini-base station for PC-1 in that the handset can be used within several hundred feet of a parked vehicle to both originate and terminate calls. Indeed, PC-1 is actually complementary to cellular radio rather than competitive. It extends the reach of the car mounted cellular equipment up to 600 feet from the car using the PC-1 handset.

Finally, we see the PC-1 handset as being used on trains in conjunction with train-based cellular equipment to handle fast handoff and on planes in conjunction with existing and future air-to-ground communications (i.e., the user would access the on-board train or on-board plane mini-base station from a seat using CT2 transmission for the on-board transmission).

IX. DATA

The proposed PC-1 system supports full-duplex asynchronous and transparent data services over a 32 kbit/s B channel. Asynchronous data employs automatic-repeat-request (ARQ) retransmission of error blocks. The user may request flow control for asynchronous character transmission. ARQ is disabled for the transparent data services. Data rates are user selectable. The supported asynchronous rates include: 300, 1200, 2400, 4800, 9600, 14,400, and 19,200 bits per second. Transparent data service is supported for all of the above and 32,000 bits per second.

X. VALUE ADDED SERVICES

The use of PC-1 CSCs allows addition of a rich array of value added services to the PC-1 offering.

XI. SECURITY

Encryption of calls is offered as an option for PC-1. Annex C of the CT2 CAIS specifies the mechanisms of basic authentication to be used in CT2 handsets. Additional fields are added to the Terminal Capabilities Information Element under CAIS to support encryption.

XII. HALF SLOT CHANNELS

PC-1 provides for future half-slot channels which will allow taking advantage of future low bit error rate speech coders and/or more efficient modulation schemes (for higher capacity).

XIII. FREQUENCY

CT2 in the UK utilizes 4 MHz (i.e., 40 channels of 100 KHz each). PC-1 uses 80 channels of 100 KHz each, or 8 MHz. Through various efficiencies of the PC-1 system, capacity is increased more than twice over the UK 40 channel CT2 approach despite use of four of the proposed 80 PC-1 channels as CSCs.

PC-1 has been designed to be fully compatible with fixed microwave in the 930-960 MHz range. PC-1 would share with fixed microwave on a secondary use basis in frequency assigned for fixed microwave. In the two free frequency bands in this range (930-931 MHz and 940-941 MHz) it is suggested that PC-1 eventually be given primary use status.

Much of the technical approach that allows PC-1 to share with fixed microwave is proprietary and will be subject to patent. However, PC-1 involves:

1) interference sensing algorithms; 2) the set up of PC-1 CSCs in frequencies which don't interfere with and are not interfered with by fixed microwave in the geographic areas of the base station; 3) the use of the intelligence in the PC-1 base station to set up calls on PC-1 traffic channels which also aren't interfered with and don't interfere with fixed microwave in the geographic area; 4) PC-1 handsets which search for the CSCs set up by the base station in each geographic area; and 5) PC-1 handsets that only operate on the CSC and traffic channels prescribed by the base station in the geographic area, thus preventing the PC-1 handset or turn on of handset from interfering with fixed microwave in the geographic area.

XIV. CONCLUSION

There are many countries in the world where frequency is unavailable for PCS, even in frequency ranges well above 1 GHz. The proposed PC-1 system, by solving the frequency problem, thus opens to the U.S. a PCS leadership role worldwide. Further, by solving the problem in the 900 MHz range without need to go above 1 GHz, lower consumer costs are achieved (less expensive handsets). At the same time, the U.S. retains compatibility with the 21 countries which have already announced they are pursuing CT2 CAIS.

Note: The foregoing very general technology discussion summarizes a 30 page technical document regarding PC-1 which EasyPhone™ would be willing to share with the FCC.

EXHIBIT 3

CHRONOLOGY OF CTP'S PCS DEVELOPMENT WORK

Date	Development
Summer 1988	Led in preparing British Telecom CT2 U.K. license application, resulting in award of U.K. CT2 License.
Fall/Winter 1988	Served as advisor to British Telecom on CT2; introduced CT2 to many U.S. RBOCs.
January/February 1989	Served as consultant to Pacific Telesis on CT2/PCS.
January 31, 1989	Submitted letter to Dr. Thomas P. Stanley outlining CT2/PCS -- believed to be first formal briefing to the FCC on the potential of PCS.
February 1989	Addressed the Technical Committee of the Cellular Telephone Industry Association (CTIA) on CT2/PCS -- the first formal briefing of the cellular industry.
July 1989	Appeared at FCC request on the first FCC panel addressing "The Future of CT2 Personal Mobile Communications."
Fall 1989	Formed EasyPhone, Inc. with BCE (Bell Canada Enterprises) -- believed to be first PCS company in the U.S.
Fall/Winter 1989	Conducted an extensive market study on PCS in the San Francisco Bay Area that revealed a potential market of 40 million users nationwide.
Spring 1990	Worked on technical approaches to frequency-sharing of PCS with fixed microwave.
June 1990	Invented with Bell Northern Research (BNR) the interference-sensing, dynamic channel allocation approach to PCS frequency-sharing with fixed microwave -- the first detailed approach demonstrating how narrow channel PCS could specifically co-exist with fixed microwave.
June 1990	Contacted CYLINK and initiated discussions on use of narrow channel CDMA for PCS.

Date	Development
September 14, 1990	Prepared and filed Experimental License Application for EasyPhone, Inc.
October 1990	Submitted BNR technical paper on the frequency-sharing technology to the FCC (Exhibit C to CTP's Pioneer's Preference Request, File No. PP-51).
October 1990	50-page document with attached technical paper on the frequency-sharing technology submitted by Northern Telecom ("Northern") to the FCC as Response to NOI in Gen. Docket 90-314.
October 1, 1990	Response to NOI Gen. Docket 90-314 describing the frequency-sharing technology submitted by CTP.
November 1990	Extended basic CTP/BNR technology to application use with narrow channel CDMA -- the development of the ISCDMA technology.
July 1990 - February 1990	Worked with CYLINK on specifications for narrow channel CDMA radios required for ISCDMA field testing.
October 1990 to date	Information on the frequency-sharing technical approach widely disseminated by CTP, BNR, and Northern to promote the approach adoption as a standard.
October, November 1990	Most PCS experimental licensees contacted by CTP and sent materials regarding the frequency-sharing technology. Follow-up discussions held with many experimental licensees.
November 1990	Presentation made by Northern to FCC on the frequency-sharing technology (Exhibit D to CTP's request for a pioneer's preference).
November 1990 to date	Participated as speaker in numerous industry seminars and panels describing the technology.
Spring 1991 to date	Working with Digidech, Inc. on use of narrow channel transmission technology with coaxial cable for PCS use in conjunction with cable television.
Fall/Winter 1991 to date	Working with Fulcrum Communications, Inc. of the U.K. on development of an interface between PCS and passive fiber optics for wireless local loop. The technology developed in this project is to be tested in the summer of 1992.